MULTIMEDIA-CAPABLE COMPUTER MANAGEMENT SYSTEM FOR SELECTIVELY OPERATING A PLURALITY OF COMPUTERS

1 **FIELD OF THE INVENTION**

2 The present invention relates generally to a computer

3 management system for coupling a plurality of remote

4 computers (e.g., personal computers, servers, etc.) to one

5 or more user workstations to allow a system user to

6 selectively access or control the plurality of remote

7 computers using the user workstation's keyboard, video

8 monitor, mouse, audio output device, audio input device or

9 input/output ("I/O") module. Specifically, audio generated

10 internal to or external to (but physically near) the remote

11 computer may be heard at the user workstation and audio

12 created at the user workstation may be heard at the remote

13 computer utilizing audio input and output devices coupled

14 to the computer management system or the remote computer.

15 Furthermore, I/O modules located at either the user

16 workstation or the remote computer allow auxiliary

17 peripheral devices (i.e., serial devices, parallel devices,

18 Universal Serial Bus ("USB") devices, switch contacts,

19 auxiliary audio channels, etc.) to be accessed and

20 controlled bi-directionally by either the user workstation

21 or the remote computer.

22

BACKGROUND OF THE INVENTION

In a typical multiple computer environment, a Local Area Network ("LAN") or Wide Area Network ("WAN") allows for each computer, or server, to be connected to several other computers such that the resources of each connected computer, or server, are available to each of the connected computers. In this networked environment, a dedicated keyboard, video monitor, mouse, audio output device, audio input device, and/or auxiliary peripheral devices may be employed for each computer or server.

To maintain proper operation of the LAN or WAN, the system administrator must maintain and monitor the individual computers including the servers. This maintenance frequently requires the system administrator to perform numerous tasks at the user console that is associated with and physically located at the computer or server. For example, to reboot a computer or to add or delete files, the system administrator is often required to operate the computer or server using its local, attached keyboard, mouse, video monitor, audio devices, and/or auxiliary peripheral devices, which may be located at a substantial distance from the system administrator's computer and from other computers or servers connected to the LAN or WAN. Consequently, to accomplish the task of

1 system administration, the system administrator must often

2 physically relocate to the user consoles of remote

3 computers and servers.

4   One alternative to physical relocation of the system

5 administrator is the installation of dedicated cables that

6 connect each remote computer or server to the system

7 administrator's computer in a manner that allows the system

8 administrator to fully access and operate the remote

9 computers or servers. However, such an alternative

10 requires substantial wiring and wire harnessing, both of

11 which may require tremendous cost that increases each time

12 a new computer is added to the system. Additionally, as

13 the distance between the system administrator's computer

14 and the computer equipment increases, a decrease in the

15 quality of the transmitted signal often results. Thus,

16 dedicated cables between the system administrator's

17 computer and remote computer equipment may not provide a

18 feasible alternative.

19   In addition to the ease of managing a networked

20 computer environment, space is also an important concern

21 for many networked computer environments, especially large-

22 scale operations such as data-centers, server-farms, web-

23 hosting facilities, and call-centers. These computer

24 environments typically require space to house a keyboard,

1   video monitor, mouse, audio output device, audio input

2   device and/or auxiliary peripheral devices for each

3   computer in addition to all of the wiring required to

4   connect and power each component to the respective

5   computer. Furthermore, additional space is required to

6   house the network interface components (e.g., a hub or

7   other connection device) and wiring (i.e., the wiring that

8   physically connects the computers together either directly

9   or via network interface components). As more equipment is

10   added to a computer network, it becomes more probable that

11   the space required to house the equipment and associated

12   cabling will exceed the space allotted for the computer

13   network. Therefore, network architecture, equipment size,

14   and available space are important issues when designing an

15   effective computer network environment.

16   One method of reducing the amount of space required to

17   house a computer network is to eliminate user interface

18   devices (i.e., keyboard, video monitor, mouse, audio output

19   device, audio input device, auxiliary peripheral devices,

20   etc.) that are not essential for proper operation of the

21   computer network. User interface devices, and associated

22   wiring, may be eliminated if a system administrator is able

23   to access the remote computers from the system

24   administrator's computer, thereby eliminating the need for

1 dedicated user interface equipment and its associated

2 wiring.

3   Allowing a system administrator to operate remote

4 computers or servers from the system administrator's

5 computer eliminates the need for physical relocation of the

6 system administrator to perform system maintenance or

7 administration. Also, this capability decreases the amount

8 of space required to house the computer network by

9 eliminating unnecessary devices.

10   The following references, which are discussed below,

11 were found to relate to the field of computer management

12 systems: Asprey U.S. Patent No. 5,257,390 ("Asprey '390

13 patent"), Asprey U.S. Patent No. 5,268,676 ("Asprey '676

14 patent"), Asprey U.S. Patent No. 5,353,409 ("Asprey '409

15 patent), Perholtz *et al.* U.S. Patent No. 5,732,212

16 ("Perholtz"), Chen U.S. Patent No. 5,978,389 ("Chen '389

17 patent"), Chen U.S. Patent No. 6,119,148 ("Chen '148

18 patent"), Fujii *et al.* U.S. Patent No. 6,138,191 ("Fujii"),

19 Beasley U.S. Patent No. 6,345,323 ("Beasley"), Pinkston, II

20 *et al.* U.S. Patent No. 6,378,009 ("Pinkston"), Thornton *et*

21 *al.* U.S. Patent No. 6,385,666 ("Thornton"), Ahern *et al.*

22 U.S. Patent No. 6,388,658 ("Ahern"), and Wilder *et al.* U.S.

23 Patent No. 6,557,170 ("Wilder").

1   The Asprey '390 patent discloses an extended range

2   communications link for coupling a computer to a keyboard,

3   video monitor, and/or mouse that is located remotely from

4   the computer. The end of the link that is coupled to the

5   computer has a first signal conditioning circuit that

6   conditions the keyboard, video monitor and mouse signals.

7   Conditioning the video monitor signals includes reducing

8   their amplitude in order to minimize the amount of

9   "crosstalk" that is induced on the conductors adjacent to

10   the video signal conductors during transmission of the

11   video signals. This signal conditioning circuit is coupled

12   to an extended range cable having a plurality of conductors

13   that transmits the conditioned signals and power and logic

14   ground potentials to a second signal conditioning circuit.

15   This second signal conditioning circuit restores the video

16   signals to their original amplitude.

17   The Asprey '676 patent discloses a communications link

18   for use between a computer and a display unit, such as a

19   video monitor, that allows these two components to be

20   located up to three hundred (300) feet apart. An encoder

21   located at the computer end of the communications link

22   receives analog red, green and blue signals from the

23   computer and inputs each signal to a discrete current

24   amplifier that modulates the signal current. Impedance

1   matching networks then match the impedance of the red,

2   green and blue signals to the impedance of the cable and

3   transmit the signals to discrete emitter-follower

4   transistors located at the video monitor end of the cable.

5   These transistors amplify the signal prior to inputting it

6   to the video monitor. Concurrently, the horizontal

7   synchronization signal is inputted to a cable conductor and

8   its impedance is not matched to the impedance of the cable,

9   thereby allowing the conductor to attenuate the horizontal

10   synchronization signal and reduce noise radiation.

11   The Asprey '409 patent discloses an extended range

12   communications link for transmitting transistor-transistor

13   logic video signals from a local computer to a video

14   monitor located up to a thousand (1,000) feet from the

15   computer. The link includes a first signal conditioning

16   circuit located at the computer end of the link for

17   reducing the amplitude of the video signals received from

18   the computer and biasing them to a selected potential,

19   whereafter, they are applied to discrete conductors of the

20   link. A second signal conditioning circuit receives and

21   reconstructs the transmitted video signals prior to

22   inputting them to the video monitor. According to the

23   Asprey '409 patent, performance of this process reduces the

24   appearance of high frequency video noise on the keyboard

1   clock conductor of the transmission cable, thereby

2   preventing keyboard errors.   The Chen '389 patent

3   discloses a video signal multiplexing device for use with a

4   single video monitor that is capable of selecting one video

5   signal from a plurality of computers for display on the

6   video monitor. The Chen system includes three sets of

7   switches for receiving the red, green, and blue components

8   of the video signals from each computer. When a user

9   selects the desired remote computer, an interface circuit

10 generates a control signal that directs the three sets of

11 switches to select the corresponding video signals from the

12 plurality of computers. The selected signals are then

13 transmitted to three sets of switch circuits and current

14 amplifying circuits that provide input and output impedance

15 matching, respectively. The selected video signal is then

16 displayed on the video monitor.

17   Perholtz discloses a method and apparatus for coupling

18 a local user workstation, including a keyboard, mouse,

19 and/or video monitor, to a remote computer. Perholtz

20 discloses a system wherein the remote computer is selected

21 from a menu displayed on a standard size personal computer

22 video monitor. Upon selection of a remote computer by the

23 system user, the remote computer's video signals are

24 transmitted to the local user workstation's video monitor.

1 The system user may also control the remote computer

2 utilizing the local user workstation's keyboard and

3 monitor. The Perholtz system is also capable of bi-

4 directionally transmitting mouse and keyboard signals

5 between the local user workstation and the remote computer.

6 The remote computer and the local user workstation may be

7 connected either via the Public Switched Telephone System

8 ("PSTN") and modems or via direct cabling.

9 The Chen '148 patent discloses a video signal

10 distributor that receives, processes and distributes video

11 signals received from one or more computers to a plurality

12 of video monitors. The video signal distributor includes

13 three transistor-based voltage amplifying circuits to

14 individually amplify the red, green and blue video signals

15 received from each computer prior to transmitting these

16 signals to a video monitor. The video signal distributor

17 also includes a synchronization signal buffering device

18 that receives horizontal and vertical synchronization

19 signals from each computer and generates new

20 synchronization signals based upon the quantity of video

21 signals that are output to the video monitors.

22 Fujii discloses a system for selectively operating a

23 plurality of computers that are connected to one common

24 video monitor. The Fujii system includes a single

1   interface device for entering data in any one of the

2   plurality of connected computers. The system also includes

3   a main control circuit, which is connected to the interface

4   device, and a selection circuit for providing the entered

5   data and receiving the video signals from the selected

6   computer.

7   Similar to Perholtz, Beasley discloses a specific

8   implementation of a computerized switching system for

9   coupling a local keyboard, mouse and/or video monitor to

10 one of a plurality of remote computers. In particular, a

11 first signal conditioning unit includes an on-screen

12 programming circuit that displays a list of connected

13 remote computers on the local video monitor. To activate

14 the menu, a user depresses, for example, the "print screen"

15 key on the local keyboard. The user selects the desired

16 computer from the list using the local keyboard and/or

17 mouse.

18   According to Beasley, the on-screen programming

19 circuit requires at least two sets of tri-state buffers, a

20 single on-screen processor, an internal synchronization

21 generator, a synchronization switch, a synchronization

22 polarizer, and overlay control logic. The first set of

23 tri-state buffers couples the red, green, and blue

24 components of the video signals received from the remote

1   computer to the video monitor. That is, when the first set

2   of tri-state buffers are energized, the red, green, and

3   blue video signals are passed from the remote computer to

4   the local video monitor through the tri-state buffers.

5   When the first set of tri-state buffers are not active, the

6   video signals from the remote computer are blocked.

7   Similarly, the second set of tri-state buffers couples the

8   outputs of the single on-screen processor to the video

9   monitor. When the second set of tri-state buffers is

10   energized, the video output of the on-screen programming

11   circuit is displayed on the local video monitor. When the

12   second set of tri-state buffers is not active, the video

13   output from the on-screen programming circuit is blocked.

14   Alternatively, if both sets of tri-state buffers are

15   energized, the remote computer video signals are combined

16   with the video signals generated by the on-screen processor

17   prior to display on the local video monitor.

18   The on-screen programming circuit disclosed in Beasley

19   also produces its own horizontal and vertical

20   synchronization signals. To dictate which characters are

21   displayed on the video monitor, the CPU sends instructional

22   data to the on-screen processor. This causes the on-screen

23   processor to retrieve characters from an internal video RAM

24   for display on the local video monitor.

1   The overlaid video image produced by the on-screen

2   processor, namely a Motorola MC141543 on-screen processor,

3   is limited to the size and quantity of colors and

4   characters that are available with the single on-screen

5   processor. In other words, the Beasley system is designed

6   to produce an overlaid video that is sized for a standard

7   size computer monitor (i.e., not a wall-size or multiple

8   monitor type video display) and is limited to the quantity

9   of colors and characters provided by the single on-screen

10 processor.

11   During operation of the Beasley system, a remote

12 computer is chosen from the overlaid video display.

13 Thereafter, the first signal conditioning unit receives

14 keyboard and mouse signals from the local keyboard and

15 mouse and generates a data packet for transmission to a

16 central cross point switch. The cross point switch routes

17 the data packet to the second signal conditioning unit,

18 which is coupled to the selected remote computer. The

19 second signal conditioning unit then routes the keyboard

20 and mouse command signals to the keyboard and mouse

21 connectors of the remote computer. Similarly, video

22 signals produced by the remote computer are routed from the

23 remote computer through the second signal conditioning

24 unit, the cross point switch, and the first signal

1 conditioning unit to the local video monitor. The

2 horizontal and vertical synchronization video signals

3 received from the remote computer are encoded on one of the

4 red, green or blue video signals. This encoding reduces

5 the quantity of cables required to transmit the video

6 signals from the remote computer to the local video

7 monitor.

8 Pinkston discloses a keyboard, video, mouse ("KVM")

9 switching system capable of coupling to a standard network

10 (e.g., a Local Area Network) operating with a standard

11 network protocol (e.g., Ethernet, TCP/IP, etc.). The

12 system of Pinkston couples a central switch to a plurality

13 of computers and at least one user station having a

14 keyboard, video monitor, and mouse. The central switch

15 includes a network interface card ("NIC") for connecting

16 the central switch to a network, which may include a number

17 of additional computers or remote terminals. Utilizing the

18 Pinkston system, a user located at a remote terminal

19 attached to the network may control any of the computers

20 coupled to the central switch.

21 Thornton discloses a computer system having remotely

22 located I/O devices. The system of Thornton includes a

23 computer, a first interface device, and a remotely located

24 second interface device. The first interface device is

1 coupled to the computer and the second interface device is

2 coupled to a video monitor and as many as three I/O devices

3 (e.g., keyboard, mouse, printer, joystick, trackball, etc.)

4 such that a human interface is created. The first and

5 second interface devices are coupled to each other via a

6 four wire cable. The first interface device receives video

7 signals from the connected computer and encodes the

8 horizontal and vertical synchronization signals of the

9 received video signals onto at least one of the red, green,

10 and blue components of the video signal. The first

11 interface device also encodes the I/O signals received from

12 the connected computer into a data packet for transmission

13 over the fourth wire in the four wire cable. Thereafter,

14 the encoded, red, green, and blue components of the video

15 signals and the data packet are transmitted to the second

16 interface device located at the human interface. The

17 second interface device decodes the encoded red, green, and

18 blue components of the video signal, separates the encoded

19 horizontal and vertical synchronization signals, and

20 decodes the I/O signal data packet. The video signal and

21 the synchronization signals are then output to the video

22 monitor attached to the second interface and the decoded

23 I/O signals are routed to the proper I/O device, also

24 attached to the second interface. The second interface

1   device may optionally include circuitry to encode I/O

2   signals received from the I/O devices attached to the

3   second interface for transmission to the first interface

4   device.

5   Ahern discloses a switching system for interconnecting

6   a plurality of computer user terminals with a plurality of

7   computers via a computer network, thereby allowing a user

8   to access any computer from any computer user terminal.

9   Each computer is interfaced to the switching system via a

10 computer interface, which conditions the bi-directional

11 keyboard and mouse signals and the uni-directional video

12 signals for transmission over a single CAT 5 cable to a

13 central switch. The computer interface also encodes the

14 bi-directional keyboard and mouse signals with the

15 horizontal and vertical synchronization signals into a data

16 packet for transmission over one of the twisted pair in the

17 CAT 5 cable. The uni-directional red, green, and blue

18 components of the video signals are transmitted as analog

19 signals over the remaining three twisted pair in the CAT 5

20 cable. The central switch contains a series of digital

21 cross point switches for routing the encoded data packet to

22 the intended user interface module, as well as a series of

23 analog cross point switches for routing the red, green, and

24 blue components of the video signals to the same user

1   interface module. Each user interface module is attached

2   to the central switch via a single CAT 5 cable. The user

3   interface module decodes the bi-directional keyboard and

4   mouse signals and outputs them to the keyboard and mouse

5   attached to the user interface. Similarly, the user

6   interface module decodes the horizontal and vertical

7   synchronization signals and outputs the resulting signals

8   as well as the analog red, green, and blue components of

9   the video signal to the video monitor attached to the user

10 interface.

11   Wilder discloses a keyboard, video, mouse and power

12 switching ("KVMP") apparatus for connecting a plurality of

13 computers to one or more user stations having an attached

14 keyboard, video monitor, and mouse. On-screen display

15 ("OSD") circuitry embedded within the KVMP switching

16 apparatus allows a user located at a user station to select

17 and operate any one of the computers utilizing the

18 keyboard, video monitor, and mouse attached to the user

19 station. Secondary switching circuitry located within the

20 KVMP switching apparatus allows a user located at a user

21 station to additionally control the electrical power supply

22 supplying each computer.

23   In view of the foregoing, a need clearly exists for a

24 multimedia-capable remote computer management system that

1 minimizes expensive, space-consuming, external computer

2 hardware, while providing full access and control to

3 multiple remote computers. Such a system should also allow

4 one or more user workstations to access any one of a

5 plurality of remote computers and its associated audio and

6 auxiliary peripheral devices. Furthermore, such a system

7 should greatly enhance the ability of information

8 technology personnel to manage multiple computers or

9 servers in both small-scale computer centers and large-

10 scale operations such as data-centers, server-farms, web-

11 hosting facilities, and call-centers.

12

13 **SUMMARY OF THE INVENTION**

14   It is often desirable to allow one or more remote

15 computers to be accessed and controlled via one or more

16 local sets of peripheral devices including, but not limited

17 to, a keyboard, video monitor, cursor control device, audio

18 output device, audio input device and auxiliary peripheral

19 devices (i.e., serial devices, parallel devices, USB

20 devices, switch contacts, auxiliary audio channels, etc.).

21 Since the majority of computers in use today are either

22 International Business Machines ("IBM") computers or clones

23 of an IBM computer, many computers use identical or similar

24 electrical connectors and communication protocols (e.g.,

1 PS/2) to connect a peripheral device to a computer. An

2 IBM-compatible computer typically contains one type of

3 electrical connector for each type of peripheral device to

4 which the computer will be connected. Generally, the

5 cables that interface such peripheral devices to the

6 respective electrical connector are approximately six feet

7 in length, thereby limiting the distance from the computer

8 at which the peripheral devices may be located.

9   In many circumstances, it may be desirable to separate

10 the peripheral devices from the computer due to space

11 constraints. However, separating a computer from its

12 peripheral devices is likely to increase cabling costs. In

13 addition, transmitting signals such as keyboard, video,

14 cursor control device, audio or auxiliary peripheral device

15 signals over distances greater than fifteen feet is likely

16 to degrade the electrical characteristics of the signal

17 resulting in decreased reliability of keyboard and cursor

18 control device commands, low quality video and audio, and

19 degraded auxiliary peripheral device signals. This

20 degradation occurs for a few reasons including the

21 induction of "noise", or "crosstalk", between adjacent

22 conductors and an increase in the impedance encountered by

23 the transmitted signal.

1   In addition to extending the distance between a

2 computer and its peripheral devices, it is also convenient

3 to access and operate more than one computer from one set

4 of peripheral devices. Again, this feature is desirable

5 when space is limited and the use of one set of peripheral

6 devices to control multiple computers eliminates the space

7 required to house a dedicated set of peripheral devices for

8 each computer to be accessed and controlled. Also, the

9 ability to access and control one or more remote computers

10 from one local set of peripheral devices eliminates the

11 need to physically relocate to the remote computer to

12 perform system administration or maintenance for that

13 computer.

14   The present invention provides an intelligent, modular

15 computer management system that enables several

16 simultaneous users to access, control, and operate numerous

17 remote computers and their associated peripheral devices

18 from one or more sets of local peripheral devices. This

19 computer management system allows a system administrator to

20 access a remote computer from one set of peripheral

21 devices, preferably located at the system administrator's

22 desk, without physically traveling to the remote computer.

23 Furthermore, if the remote computer does not have a local

1   user, the present invention eliminates the need for a

2   second set of peripheral devices at the remote computer.

3   The present invention also provides compatibility

4   between various operating systems and/or communication

5   protocols. The present invention allows the same set of

6   local peripheral devices to access and control remote

7   computers executing a variety of operating systems and

8   protocols, including but not limited to, those manufactured

9   by Microsoft Corporation ("Microsoft") (Windows), Apple

10   Computer, Inc. ("Apple") (Macintosh), Sun Microsystems,

11   Inc. ("Sun") (Unix), Digital Equipment Corporation ("DEC"),

12   Compaq Computer Corporation ("Compaq") (Alpha), IBM

13   (RS/6000), Hewlett-Packard Company ("HP") (HP9000), and SGI

14   (formerly "Silicon Graphics, Inc."). Additionally, local

15   devices may communicate with remote computers via a variety

16   of protocols including, but not limited to, USB, American

17   Standard Code for Information Interchange ("ASCII"), and

18   Recommend Standard-232 ("RS-232").

19   A variety of cabling mechanisms may be used to connect

20   the user workstations and the remote computers to the

21   computer management system of the present invention. The

22   preferred embodiment of the present invention incorporates

23   a single Category 5 Universal Twisted Pair ("CAT 5") cable

24   to connect each remote computer and each user workstation

1   to the computer management system. However, other cabling

2   may be used without departing from the spirit of the

3   present invention.

4   To achieve the desired administration efficiency while

5   reducing costs and promoting space conservation, the

6   present invention provides a system with reduced cabling

7   requirements. In addition, the architecture of the present

8   invention is designed to minimize the quantity of

9   peripheral devices associated with each remote computer.

10   Further, it is an object of the present invention to allow

11   audio generated internal to or external to a remote

12   computer to be played at near CD quality at a user

13   workstation.

14   Therefore, it is an object of the present invention to

15   allow a remote computer's auxiliary peripheral devices to

16   be accessed and controlled by a local user workstation.

17   It is also an object of the present invention to allow

18   bi-directional communication of the auxiliary peripheral

19   device signals between the user workstation and one or more

20   remote computers.

21   It is yet another object of the present invention to

22   allow audio generated at a user workstation to be played at

23   near CD quality at a remote computer.

1   Also, it is an object of the present invention to

2 provide an improved, modular computer management system

3 that is reliable while minimizing the quantity of expensive

4 and space-consuming peripheral devices required to access

5 and operate multiple remote computers.

6   Further, it is an object of the present invention to

7 provide a modular computer management system that allows

8 one or more sets of peripheral devices to access and

9 operate one or more remote computers as if the local

10 peripheral devices were directly connected to the remote

11 computers.

12   Furthermore, it is an object of the present invention

13 to allow information technology ("IT") personnel to easily

14 manage a volume of servers for both small-scale computer

15 centers and large-scale computer centers such as data-

16 centers, server-farms, web-hosting facilities, and call-

17 centers.

18   Also, it is an object of the present invention to

19 allow IT personnel to easily communicate with each other

20 when managing two distinct computers separated by an

21 extended distance.

22   It is a further object of the present invention to

23 provide a modular computer management system that is easy

24 to install and operate.

1   In addition, it is an object of the present invention

2   to provide a modular computer management system that is

3   relatively small in size, thereby minimizing the space

4   required to house the computers, peripheral devices and the

5   computer management system.

6   Furthermore, it is an object of the present invention

7   to provide a computer management system that allows high

8   resolution video to be displayed at an extended distance

9   from the computer at which the video signals originate.

10   Further, it is an object of present invention to

11   provide a modular computer management system, which allows

12   error-free communications between peripheral devices of a

13   user workstation and computers located at an extended

14   distance from the user workstation.

15   It is also an object of the present invention to

16   provide a modular computer management system that provides

17   enhanced tuning to amplify and condition video signals

18   after transmission over an extended range.

19   Other objects, features, and characteristics of the

20   present invention, as well as the methods of operation and

21   functions of the related elements of the structure, and the

22   combination of parts and economies of manufacture, will

23   become more apparent upon consideration of the following

1 detailed description with reference to the accompanying

2 drawings, all of which form a part of this specification.

3

4 **BRIEF DESCRIPTION OF THE DRAWINGS**

5   A further understanding of the present invention can

6 be obtained by reference to a preferred embodiment and

7 alternate embodiments set forth in the illustrations of the

8 accompanying drawings. Although the illustrated

9 embodiments are merely exemplary of systems for carrying

10 out the present invention, both the organization and method

11 of operation of the invention, in general, together with

12 further objectives and advantages thereof, may be more

13 easily understood by reference to the drawings and the

14 following description. The drawings are not intended to

15 limit the scope of this invention, which is set forth with

16 particularity in the claims as appended or as subsequently

17 amended, but merely to clarify and exemplify the invention.

18   For a more complete understanding of the present

19 invention, reference is now made to the following drawings

20 in which:

21   FIG. 1 is a schematic representation of the remote

22 computer management system according to the preferred

23 embodiment of the present invention illustrating the

24 connection of multimedia user workstations and multiple

1 remote computers to one Matrix Switching Unit ("MSU") via

2 CAT 5 cables.

3 FIG. 2A is a schematic representation is a schematic

4 representation of the preferred embodiment of the internal

5 structure of the multimedia UST shown in FIG. 1, including

6 the attached peripheral devices.

7 FIG. 2B is a detailed schematic diagram of the

8 preferred embodiment of the UST transceiver and data

9 converter located within the multimedia UST of FIG. 2A.

10 FIG. 2C is a schematic representation of the preferred

11 embodiment of the tuning circuit shown in FIG. 2A, which

12 compensates for the amplitude and frequency reduction that

13 occurs during video signal transmission.

14 FIG. 3A is a schematic representation of the MSU shown

15 in FIG. 1 according to the preferred embodiment of the

16 present invention illustrating a block diagram of the

17 internal structure of the MSU and electrical connectors for

18 CAT 5 cables.

19 FIG. 3B is a detailed schematic diagram of the

20 preferred embodiment of the first and second transceivers

21 located within the MSU shown in FIG. 3A.

22 FIG. 4A is a schematic representation of the preferred

23 embodiment of the internal structure of the multimedia CIM

1 shown in FIG. 1, illustrating connection of the CIM to a

2 connected computer and to an MSU.

3   FIG. 4B is a detailed schematic diagram of the

4 preferred embodiment of the CIM transceiver and data

5 converter located within the CIM of FIG. 4 in accordance

6 with the present invention.

7   FIG. 5 is a schematic representation of a data packet

8 used to transmit data in the remote computer management

9 system according to the preferred embodiment of the present

10 invention.

11   FIG. 6 is a timing diagram showing the transmission of

12 a data packet from a multimedia UST to a multimedia CIM via

13 an MSU and from a multimedia CIM to a multimedia UST via an

14 MSU according to the preferred embodiment of the present

15 invention.

16   FIG. 7 is a schematic representation of an alternate

17 configuration of the computer management system for use

18 with the present invention illustrating connection of

19 multiple user workstations and multiple connected computers

20 to multiple MSUs, wherein the alternate embodiment may

21 accommodate as many as sixty-four (64) user workstations

22 and ten thousand (10,000) connected computers.

23   FIG. 8 is a schematic representation of an alternate

24 embodiment of the computer management system of the present

1   invention, wherein the computer management system is

2   contained in a single unit that is directly connected to

3   all connected computers and user workstations.

4

5   **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

6   As required, detailed illustrative embodiments of the

7   present invention are disclosed herein. However,

8   techniques, systems and operating structures in accordance

9   with the present invention may be embodied in a wide

10 variety of forms and modes, some of which may be quite

11 different from those in the disclosed embodiment.

12 Consequently, the specific structural and functional

13 details disclosed herein are merely representative, yet in

14 that regard, they are deemed to afford the best embodiment

15 for purposes of disclosure and to provide a basis for the

16 claims herein, which define the scope of the present

17 invention. The following presents a detailed description

18 of the preferred embodiment (as well as some alternative

19 embodiments) of the present invention.

20   Referring first to FIG. 1, depicted is the

21 architecture of the preferred embodiment of the present

22 invention. Specifically, a modular, intelligent, computer

23 management system is shown including a centrally located

24 MSU 112, multimedia user workstations 100, multimedia CIMs

1   116, CIM audio output devices 126, CIM audio input devices

2   128, CIM I/O modules 130, and remote computers 118. Each

3   multimedia user workstation 100 comprises multimedia UST

4   108, keyboard 102, video monitor 104, cursor control device

5   106, UST audio output device 120, UST audio input device

6   122, and UST I/O module 124. Furthermore, each multimedia

7   UST 108 and multimedia CIM 116 is connected to MSU 112 via

8   cables 110 and 114, respectively. Although the computer

9   management system is discussed herein with respect to the

10   multimedia embodiment of the present invention, it should

11   be noted that the present invention is also capable of

12   operating with non-multimedia USTs and non-multimedia CIMs.

13   Although single CAT 5 cabling is the preferred cabling

14   for use with the present invention, other cabling may be

15   used, such as coaxial, fiber optic, or multiple CAT 5

16   cables, depending on the specific needs of the system user.

17   CAT 5 cabling is preferred because it reduces cabling costs

18   while maintaining the strength of the signals that are

19   transmitted over extended distances. Additionally, the use

20   of single CAT 5 cabling minimizes the space required to

21   house the computer system and its associated wiring.

22   Individual CAT 5 cables may be used for connection of

23   each multimedia UST 108 and each multimedia CIM 116 to MSU

24   112. Conventional CAT 5 cables include four (4) twisted

1   pair of wires. The present invention utilizes three (3) of

2   these twisted pair for the transmission of video signals.

3   Each of the three (3) twisted pair transmits one of the

4   three video color signals (i.e., red, green or blue). To

5   allow all video signals to be transmitted via only (3)

6   twisted pair, the horizontal and vertical synchronization

7   signals, which would otherwise require their own twisted

8   pairs, are individually encoded on one of the red, green,

9   or blue video signals. That is, each synchronization

10   signal is encoded on its own, dedicated color signal. For

11   example, the vertical synchronization signal may be encoded

12   on the blue video signal while the horizontal

13   synchronization signal may be encoded on the green video

14   signal. All other non-video signals such as keyboard,

15   cursor control device, and audio signals, are transmitted

16   via the fourth twisted pair cable.

17   The single CAT 5 cables are connected to multimedia

18   UST 108, MSU 112, and multimedia CIM 116 by plugging each

19   end into a RJ-45 connector located on these respective

20   components. Although RJ-45 connectors are preferred, other

21   types of connectors may be used, including but not limited

22   to RJ-11, RG-58, RG-59, British Naval Connector ("BNC"),

23   and ST connectors.

1   UST audio output device 120 and CIM audio output

2   device 126 of the present invention may be any device that

3   is capable of receiving audio signals. For example, UST

4   audio output device 120 and CIM audio output device 126 may

5   be the audio in port of remote computer 118, a speaker, an

6   analog recording device, a digital recording device, an

7   audio-equipped projector, an audio-equipped camcorder, an

8   audio-equipped camera, a television, a telephone, a

9   cellular telephone, a computer distinct from remote

10   computer 118, etc. Similarly, UST audio input device 122

11   and CIM audio input device 128 may be any device that is

12   capable of generating or transmitting audio signals. For

13   example, UST audio input device 122 and CIM audio input

14   device 128 may be the audio out port of remote computer

15   118, a microphone, an analog playback device, a digital

16   playback device, an audio-equipped projector, an audio-

17   equipped camcorder, an audio-equipped camera, a telephone,

18   a cellular telephone, a television, a Videocassette

19   Recorder ("VCR"), a DVD player, a CD-player, a computer

20   distinct from remote computer 118, etc.

21   UST I/O module 124 and CIM I/O module 130 of the

22   present invention are used to connect auxiliary peripheral

23   devices to the multimedia UST 108 and multimedia CIM 116,

24   respectively. UST I/O module 124 and CIM I/O module 130

1 may contain one or more ports of varying types for

2 connection of auxiliary peripheral devices. The types of

3 ports include, but are not limited to, Universal Serial Bus

4 ("USB"), Recommended Standard 232 ("RS-232"), PS/2,

5 Registered Jack 11 ("RJ-11"), Registered Jack 31 ("RJ-31"),

6 Registered Jack 45 ("RJ-45"), Registered Jack 48 ("RJ-48"),

7 British Naval Connector ("BNC"), Centronics, Advanced

8 Technology ("AT"), Super Video ("S-Video"), Digital Video

9 Interface ("DVI"), Integrated Development Environment

10 ("IDE"), Fiber Distributed Data Interface ("FDDI"), Small

11 Computer System Interface ("SCSI"), and switch contact.

12   Various types of auxiliary peripheral devices may be

13 connected to UST I/O module 124 and CIM I/O module 130.

14 Some examples of auxiliary peripheral devices include, but

15 are not limited to, a keyboard, a cursor control device, an

16 optical cursor control device, a trackball, a USB

17 keyboard/cursor control device adapter, a port expander, a

18 Bluetooth device, a cellular telephone, a web camera, a

19 floppy disk drive, a hard disk drive, a USB Flash Drive, a

20 digital media reader/writer, a microphone, a speaker, a

21 subwoofer, a scanner, a copier, a printer, a projector, a

22 television, an analog monitor, a digital monitor, a video

23 capture device, a modem, a hub, a router, a switch, a cable

24 modem, a DSL modem, a wireless network hub, a wireless

1   network router, a wireless access point, a print server, a

2   wireless print server, an Ethernet adapter, an analog audio

3   playback device, an analog audio recording device, a

4   digital audio playback device, a digital audio recording

5   device, a tape drive, a storage backup device, a joystick,

6   a game pad, a power supply, an uninterruptible power supply

7   ("UPS"), a USB hub, a CD-ROM device, a CD-RW device, a DVD-

8   ROM device, a DVD-RAM device, a camera, a camcorder, a

9   fingerprint reader, a retina scanner, and a biometric

10 authentication device.

11   Each auxiliary peripheral device may either be coupled

12 to multimedia UST 108 via UST I/O module 124 or to

13 multimedia CIM 116 via CIM I/O module 130. For example, a

14 CD-ROM device may be attached to a multimedia UST 108 to

15 allow a system administrator to perform software upgrades.

16 The system administrator can then access and upgrade each

17 remote computer utilizing the CD-ROM device attached to the

18 system administrator's multimedia UST 108. As another

19 example, a tape drive may be attached to a multimedia UST

20 108 to allow a system administrator to backup multiple

21 computers from the same multimedia user workstation 100

22 utilizing a single tape drive.

23   Additionally, auxiliary peripheral devices may be used

24 for security purposes. For example, a fingerprint reader

1   may be attached to a multimedia user workstation 100 to

2   read the identity of the individual attempting to operate

3   it. The system may be programmed to only allow a system

4   administrator to access and operate remote computer 118

5   upon fingerprint authentication by the respective remote

6   computer 118. In this manner, user access to each remote

7   computer 118 may be controlled by verifying the identity of

8   the user.

9   Similarly, any of the aforementioned auxiliary

10   peripheral devices may be attached to multimedia CIM 116.

11   For example, a microphone may be attached to multimedia CIM

12   116 to allow voice communication between a person located

13   at multimedia CIM 116 and a person located at multimedia

14   user workstation 100. This capability greatly enhances the

15   system administration of remote computers 118 by allowing a

16   system administrator located at multimedia CIM 116 to more

17   effectively communicate with another system administrator

18   located at multimedia user workstation 100.

19   The aforementioned examples are for illustrative

20   purposes only and are not intended to define all of the

21   embodiments of the present invention. Many other

22   combinations of auxiliary peripheral devices are possible

23   without departing from the spirit of the present invention.

1   Each multimedia user workstation 100 of the

2   intelligent, modular computer management system of the

3   present invention receive signals from attached keyboard

4   102, cursor control device 106, UST audio output device

5   120, UST audio input device 122, and UST I/O module 124.

6   The signals received at multimedia UST 108 are packetized

7   (i.e., converted to one or more data packets), as discussed

8   in greater detail below, and transmitted to MSU 112 via

9   single cable 110. In the preferred embodiment, the data

10   packets are also encoded utilizing Manchester code.

11   Manchester code is a standard code used to transmit data in

12   which data and clock signals are combined to form a single

13   self-synchronizing data stream. Manchester encoding

14   guarantees that there are transitions in the signal for

15   every bit transmitted, thus allowing for better data

16   recovery in long length cables. At MSU 112, the packetized

17   signals are processed to create new data packets, which are

18   transmitted to multimedia CIM 116 via cable 114.

19   Multimedia CIM 116 then processes the received data packets

20   and emulates keyboard and cursor control device signals to

21   the corresponding ports of remote computer 118.

22   Additionally, multimedia CIM 116 is capable of emulating

23   audio to CIM audio output device 126 or auxiliary

24   peripheral device signals to CIM I/O module 130.

1   Conversely, multimedia CIM 116 receives signals from

2   attached remote computer 118, CIM audio input device 128,

3   and CIM I/O module 130. Specifically, the signals received

4   from remote computer 118 include keyboard, video, and

5   cursor control device signals. Multimedia CIM 116 then

6   packetizes the received keyboard, cursor control device,

7   audio, and auxiliary peripheral device signals and

8   transmits the generated data packets along with the video

9   signals, as discussed in greater detail below, to MSU 112

10   via cable 114. At MSU 112, the data packets are processed

11   and new data packets are generated and transmitted along

12   with the video signals to multimedia UST 108 via single

13   cable 110. Multimedia UST 108 then applies the received

14   video signals to attached video monitor 104 and emulates

15   keyboard and cursor control device signals to keyboard 102

16   and cursor control device 106, respectively. Also,

17   multimedia UST 108 is capable of emulating audio to

18   attached UST audio output device 120 and emulating

19   auxiliary peripheral device signals to UST I/O module 124.

20   The computer management system of the present

21   invention allows a system user to select a remote computer

22   118 even if it is not powered. This novel feature allows a

23   system user to select the unpowered remote computer 118,

24   apply power to it, and thereafter view its boot up

1   sequence.   Viewing the boot up sequence allows a system

2   user to view all BIOS (i.e., a set of routines stored in .

3   the PC that provides an interface between the PC hardware

4   and its operating system) activity occurring from the time

5   at which power is applied.

6   Furthermore, for simplicity, FIG. 1 depicts an

7   embodiment of the computer management system of the present

8   invention that connects eight (8) multimedia USTs 108 and

9   thirty-two (32) multimedia CIMs 116 to one MSU 112.

10   However, the computer management system of the present

11   invention may comprise more than one MSU 112.   For example,

12   multiple MSUs 112 may be configured in a tiered or hub

13   configuration to connect a virtually unlimited quantity of

14   multimedia user workstations 100 with a virtually unlimited

15   quantity of remote computers 118 while still achieving

16   optimal results.   Two alternate configurations are

17   discussed in greater detail below with respect to FIGS. 7

18   and 8.

19   Selection of remote computer 118 from multimedia user

20   workstation 100 may be accomplished using a variety of

21   methods.   One such method is choosing remote computer 118

22   from a list displayed at video monitor 104.   This list is

23   generated by a menu circuit embedded within the computer

24   management system.   The menu circuit generates a display on

1 video monitor 104 to facilitate system programming and

2 provide information that is useful for system operation.

3 Furthermore, multiple security features such as passwords,

4 system user histories, etc. may be implemented and operated

5 in conjunction with the menu circuit and its generated

6 display.

7 The list generated by the computer management system

8 of the present invention includes a "drill down" feature.

9 In other words, the computer management system may be

10 configured to allow a system user to select a short list of

11 remote computers 118 based upon specific criteria (e.g.,

12 the function performed by the computer, the server rack or

13 server room in which the computer is located, the floor of

14 the building on which the computer is located, etc.) in

15 lieu of scrolling through a list of all connected remote

16 computers 118. Since the computer management system of the

17 present invention may connect a virtually unlimited

18 quantity of remote computers, this feature helps a system

19 user to quickly locate a single computer.

20 Turning next to FIG. 2A, depicted is a schematic

21 diagram of the preferred internal structure of multimedia

22 UST 108 according to the present invention. Multimedia UST

23 108 interfaces the components of multimedia user

24 workstation 100 (i.e., keyboard 102, video monitor 104,

1   cursor control device 106, UST I/O module 124, UST audio

2   output device 120, and UST audio input device 122) for use

3   with the computer management system of the present

4   invention. Keyboard 102, video monitor 104, cursor control

5   device 106, UST audio output device 120, and UST audio

6   input device 122 are connected to keyboard port 300, video

7   port 312, cursor control device port 310, UST audio out

8   port 320, and UST audio in port 322 of multimedia UST 108,

9   respectively, using industry standard keyboard, video,

10 cursor control device, and audio cabling. In the preferred

11 embodiment of the present invention, UST I/O module 124 is

12 connected to UST I/O port 318 via a 40-pin ribbon cable.

13 However, it will be apparent to one of skill in the art

14 that multimedia UST 108 and UST I/O module 124 can be

15 designed to utilize any type of cable for coupling

16 multimedia UST 108 to UST I/O module 124 including, but not

17 limited to, coaxial cable, fiber optic cable, CAT 1 cable,

18 CAT 2 cable, CAT 3 cable, CAT 4 cable, CAT 5 cable, CAT 5e

19 cable, CAT 6 cable, and CAT 7 cable. Furthermore, UST I/O

20 module 124 may be a standalone device or may be internal to

21 multimedia UST 108.

22   UST CPU 308 receives signals from keyboard 102 and

23 cursor control device 106 via keyboard port 300 and cursor

24 control device port 310, respectively. Thereafter, UST CPU

1   308 transmits information to UST transceiver 306 via data

2   converter 324 to allow the information to be included in a

3   data packet to be created by UST transceiver 306.

4   Simultaneously, data converter 324 receives signals

5   from UST I/O module 124 and UST audio input device 122 via

6   UST I/O port 318 and UST audio in port 322, respectively.

7   Additionally, signals relating to the keyboard and cursor

8   control device information are received from UST CPU 308

9   for inclusion in the data packet. UST transceiver 306

10   combines the received keyboard signals, cursor control

11   device signals, audio signals, I/O module signals, and

12   administrative signals to create data packets.

13   As shown in FIG. 2B, which depicts a schematic diagram

14   of UST transceiver 306 and data converter 324, the UST I/O

15   module signals are received from UST I/O module 124 via UST

16   I/O port 318 and are input to bit converter 350 located in

17   data converter 324. Bit converter 350 translates UST I/O

18   module signals into a parallel data format. Similarly, the

19   audio signals are received from UST audio input device 122

20   via UST audio in port 322 and are converted to digital

21   signals by analog-digital converter ("AD converter") 352.

22   The digitized audio signals are then input to audio rate

23   converter 354 which formats the rate of data flow.

24   Additionally, signals relating to the keyboard and cursor

1 control device information are received from UST CPU 308

2 and are input to serial rate converter 356 which converts

3 the keyboard and cursor control device signals to a serial

4 format.

5   UST transceiver 306 combines the signals received from

6 audio rate converter 354, serial rate converter 356, and

7 bit converter 350 to create data packets in packetizer 358,

8 as discussed in further detail below with respect to FIG.

9 5. It should be noted that the I/O module signals

10 typically contain the same information as the auxiliary

11 peripheral device signals mentioned above. The reason for

12 this is that UST I/O module 124 and CIM I/O module 130 are

13 used to interface auxiliary peripheral devices to

14 multimedia UST 108 and multimedia CIM 116, respectively.

15 In addition, the data packet contains overhead data, also

16 discussed in more detail below for FIG. 5. Thereafter, UST

17 transceiver 306 converts the data packets to a serial

18 format utilizing serializer 360 and encodes the data packet

19 utilizing encoder 362. Signal converter 364 then

20 conditions the data packet for transmission over a single

21 CAT 5 cable by converting the data packet to a differential

22 signal for transmission over a single twisted pair located

23 in the CAT 5 cable and by applying the proper network

24 protocol to the data packet. The data packet is then

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1   transmitted to port 302 for transmission to MSU 112 via

2   cable 110. Timing circuit 366 directs serializer 360 and

3   signal converter 364 to create and transmit a new data

4   packet every twenty (20) microseconds to ensure constant

5   data flow.

6   Keyboard, cursor control device, I/O module, and audio

7   signals in the form of a data packet are received from MSU

8   112 via cable 110 at port 302. Signal converter 364

9   located in UST transceiver 306 converts the data packet

10   from a differential form to its original form and removes

11   network protocol conditioning performed by MSU 112. Next,

12   the data packet is decoded by decoder 368 and de-serialized

13   by de-serializer 370. Timing circuit 366 instructs de-

14   serializer 370 to de-serialize a data packet every twenty

15   (20) microseconds to ensure constant data packet flow. The

16   data packet is then processed by separator 372 which parses

17   the data packet into its original components.

18   The received audio signals are processed by audio rate

19   converter 374 located in data converter 324. Audio rate

20   converter 374 synchronizes and converts the received data

21   rate to precisely timed data required by audio digital-to-

22   analog converter 376. The digital audio signals are then

23   converted to analog signals in audio digital-to-analog

24   converter ("DAC converter") 376 and undergo signal

1 amplification by signal amplifier 378. The amplified

2 analog audio signals are then applied to UST audio out port

3 320.

4 The received I/O module signals are conditioned by bit

5 shifter 380 which converts the I/O module signals from a

6 parallel format to their original format. The I/O module

7 signals are then transmitted to UST I/O module 124 via UST

8 I/O module port 318. The keyboard and cursor control

9 device signals are processed by rate converter 382 and

10 passed through data converter 324 to UST CPU 308, which

11 uses the information contained in the signals to emulate

12 keyboard and cursor control device signals. These emulated

13 signals are applied to keyboard 102 and cursor control

14 device 106 via keyboard port 300 and cursor control device

15 port 310, respectively (FIG. 2A).

16 Referring to FIG. 5, provided is an example of a data

17 packet used to transmit keyboard, cursor control device,

18 audio, and auxiliary peripheral device signals in

19 accordance with the preferred embodiment. The system of

20 the present invention utilizes the same data packet

21 structure to transmit keyboard signals, cursor control

22 device signals, audio signals, and auxiliary peripheral

23 device signals from multimedia CIM 116 to multimedia UST

24 108 and vice versa. The preferred embodiment of data

1 packet 500 consists of sixty-four (64) bits. First section

2 502 comprises two bits that contain instructional data

3 (i.e., command data) and data regarding the total length of

4 data packet 500.

5   Second section 504 of data packet 500 comprises

6 thirty-four (34) bits and is dedicated to the transmission

7 of audio data. Sixteen (16) bits are utilized for the left

8 stereo audio channel and sixteen (16) bits are utilized for

9 the right stereo audio channel. The remaining two bits of

10 second section 504 are checksum bits that are used to

11 ensure that the audio data is transmitted without error.

12   Third section 506 of data packet 500 comprises ten

13 (10) bits and is dedicated to the transmission of keyboard,

14 cursor control device, and administrative information

15 including characters typed on keyboard 102 or clicks

16 performed with cursor control device 106 (FIG. 1). Eight

17 (8) of the ten (10) bits are utilized to transmit the

18 keyboard, cursor control device, and administrative

19 information, one bit is used as a parity bit for use in a

20 parity check, and the final bit is utilized as a control

21 bit. The control bit is used to signal if data is present

22 in the data packet. The control bit is additionally

23 utilized to select if the data packet is transmitted to MSU

24 CPU 212.

1   Fourth section 508 of data packet 500 comprises the

2   remaining eighteen bits of data packet 500 and is utilized

3   to transmit auxiliary peripheral device signals such as

4   those received from CIM I/O module 130 or UST I/O module

5   124.

6   Multimedia UST 108 continuously transmits one data

7   packet 500 approximately every twenty five (25)

8   microseconds, even if multimedia UST 108 is not connected

9   to the computer management system. Additionally, for

10   simplicity, there is no packet acknowledge. That is,

11   multimedia UST 108 and multimedia CIM 116 do not transmit

12   an acknowledgement signal to multimedia CIM 116 or

13   multimedia UST 108, respectively, to acknowledge that a

14   data packet has been received.

15   As each data packet 500 is received at MSU 112, it is

16   received and processed and, thereafter, a new data packet

17   500 is created, as discussed above with respect to FIG. 2A.

18   During processing of data packet 500, MSU 112 creates a new

19   third section 506 of data packet 500. The remainder of

20   data packet 500 (i.e., first section 502, second section

21   504, and fourth section 508) is passed through MSU 112

22   without change.

23   Similarly, keyboard, cursor control device, I/O

24   module, and audio signals received from MSU 112 via cable

1   110 (FIG. 1) are received via port 302. UST transceiver

2   306 receives, de-serializes, and transmits these signals to

3   data converter 324. The received audio signals are

4   converted to analog signals and are applied to UST audio

5   output device 120 via UST audio out port 320. The received

6   I/O module signals are converted and transmitted TO UST I/O

7   module 124 via UST I/O module port 318. The keyboard and

8   cursor control device signals are passed unprocessed

9   through data converter 324 to UST CPU 308, which uses the

10 information contained in the signals to emulate keyboard

11 and cursor control device signals to keyboard 102 and

12 cursor control device 106 via keyboard port 300 and cursor

13 control device port 310, respectively.

14   UST CPU 308 of the present invention is programmed to

15 automatically create keyboard and cursor control device

16 signals that are compatible with the communication protocol

17 of the connected keyboard 102 and cursor control device

18 106, even though the original keyboard and cursor control

19 device signals generated at the remote computer 118 (FIG.

20 1) may not be compatible with the communication protocol of

21 keyboard 102 and cursor control device 106. That is, the

22 keyboard and cursor control device signals are not simply

23 transmitted from keyboard 102 and cursor control device 106

24 to the respective ports of remote computer 118 and vice

1   versa. Rather, information regarding the entered signals

2   is transmitted between UST CPU 308 and CIM CPU 406 (FIG.

3   4A), and these CPUs intelligently emulate the keyboard and

4   cursor control device signals in a format that will be

5   understood by the equipment receiving the signals (i.e.,

6   keyboard 102, cursor control device 106, or remote computer

7   118). This novel feature allows any type of computer to be

8   connected to the computer management system of the present

9   invention. Furthermore, this feature allows the computer

10   management system to provide compatibility between

11   computers and auxiliary peripheral devices that otherwise

12   would not be compatible.

13   Unidirectional video signals are also received at port

14   302 from MSU 112 via cable 110 (FIG. 1). However, because

15   the amplitudes of the transmitted signals are greatly

16   reduced and the frequencies of the signals are attenuated,

17   the video signals are not transmitted to UST transceiver

18   306, but rather are transmitted to tuning circuitry 304

19   that conditions the video signals. FIG. 2C depicts a

20   schematic representation of tuning circuitry 304. Tuning

21   circuitry 304 preferably comprises red variable gain

22   amplifier 710a, green variable gain amplifier 710b, blue

23   variable gain amplifier 710c, red frequency compensation

24   amplifier 712a, green frequency compensation amplifier

1   712b, blue frequency compensation amplifier 712c, slow peak

2   detector 714, voltage source 716, comparator 718, slow peak

3   detector 724, voltage source 726, comparator 728, video

4   switch 730, fast peak detector 732, and comparator 734.

5   During operation, the keyboard, video, and cursor

6   control device signals from remote computer 118 are

7   transmitted via cable 418 to CIM 116 (FIGs. 1 and 4).

8   Thereafter, the video signals and data packets generated by

9   CIM CPU 406 are transmitted from CIM 116 to MSU 112 via CAT

10   5 cable 114 (FIGs. 1 and 4). At this point in the video

11   signal transmission, the amplitudes of the transmitted

12   video signal may be greatly reduced and the frequencies of

13   the video signal may be attenuated. Subsequently, the

14   video signal and the signals generated by MSU CPU 212 are

15   transmitted from MSU 112 to UST 108, wherein the video

16   signal is conditioned by tuning circuitry 304.

17   As previously discussed, the video signal is degraded

18   during transmission over an extended range. Specifically,

19   the amplitudes of the video signals are reduced and the

20   frequencies of the video signals are greatly attenuated.

21   Therefore, tuning circuitry 304 is implemented to

22   automatically tune the received signals to achieve the

23   desired amplitude and frequency.

1   In the preferred embodiment, the horizontal

2 synchronization signal is encoded on and transmitted with

3 the green video signal, and the vertical synchronization

4 signal is encoded on and transmitted with the blue video

5 signal. However, it is known to one of ordinary skill in

6 the art that the horizontal and vertical synchronization

7 signals may be encoded on and transmitted with any one of

8 the red, green, or blue video signals. Preferably, the

9 horizontal and vertical synchronization signals are encoded

10 as negative pulses, since the video signals (i.e., red,

11 green, and blue) are typically positive pulses.

12   Tuning circuitry 304, as depicted in FIG. 2C, contains

13 three dedicated signal conditioning circuits (i.e., one for

14 each of the red, blue, and green video color signals), a

15 gain amplification adjustment circuit 715, a frequency

16 compensation amplification adjustment circuit 735, and an

17 additional filtering enablement circuit 725.

18   In operation, the red component of the video signal is

19 initially transmitted to red variable gain amplifier 710a

20 and red variable frequency compensation amplifier 712a.

21 Preferably, red variable gain amplifier 710a adjusts the

22 amplitude of the red component of the video signal based

23 upon the output of gain amplification adjustment circuit

24 715. Concurrently, red variable frequency compensation

1 amplifier 712a adjusts the frequency of the red component

2 of the video signal based upon the output of frequency

3 compensation amplification adjustment circuit 735. The

4 outputs of red variable gain amplification circuit 710a and

5 red frequency compensation circuit 712a are electrically

6 combined and transmitted via wire 722 to video port 312 for

7 transmission to video monitor 104.

8   The green component of the video signal, with the

9 encoded horizontal synchronization signal, is initially

10 transmitted to green variable gain amplifier 710b and green

11 variable frequency compensation amplifier 712b. The two

12 outputs are then electrically combined and transmitted to

13 gain amplification adjustment circuit 715 and frequency

14 compensation amplification adjustment circuit 735. Gain

15 amplification circuit 715 comprises slow peak detector 714

16 that receives the electrically combined outputs of green

17 variable gain amplifier 710b and green variable frequency

18 compensation amplifier 712b. Slow peak detector 714

19 detects the amplitude of the horizontal synchronization

20 signal, which is encoded on the green component of the

21 video signal, and transmits a signal representing this

22 amplitude to comparator 718 and comparator 734. Comparator

23 718 then compares the signal received from slow peak

24 detector 714 to a constant reference voltage supplied by

1   voltage source 716. The signal supplied by voltage source

2   716 represents the desired amplitude for the horizontal

3   synchronization signal. Next, comparator 718 transmits a

4   signal to red variable gain amplifier 710a, green variable

5   gain amplifier 710b, and blue variable gain amplifier 710c

6   to adjust the level of amplification of the red, green, and

7   blue components of the video signal until the desired

8   amplitude is achieved.

9   Similarly, green variable frequency compensation

10 amplifier 712b adjusts the level of amplification of the

11 frequency of the horizontal synchronization signal based

12 upon the output of frequency compensation amplification

13 adjustment circuit 735. Frequency compensation

14 amplification adjustment circuit 735 comprises fast peak

15 detector 732 that also receives the electrically combined

16 outputs of green variable gain amplifier 710b and green

17 variable frequency compensation amplifier 712b. Fast peak

18 detector 732 detects the rising edge of the horizontal

19 synchronization signal and transmits a signal representing

20 this rising edge to comparator 734. Then, comparator 734

21 compares the signal received from fast peak detector 732 to

22 the output of slow peak detector 714 to compare the

23 amplitude of the rising edge of the horizontal

24 synchronization signal pulse to the amplitude of the

1 horizontal synchronization signal pulse itself. Next,

2 comparator 734 sends a signal that is fed to red variable

3 frequency compensation amplifier 712a, green variable

4 frequency compensation amplifier 712b, and blue variable

5 frequency compensation amplifier 712c to adjust the level

6 of amplification of the red, green, and blue components of

7 the video signal until the desired frequency is achieved.

8 Optionally, the signal transmitted by comparator 734 may be

9 manually adjusted using manual input 733 by a system user

10 (e.g., via the menu displayed on the video monitor). Such

11 a feature would allow the system user to manually "tweak"

12 the gain of the video signals until a desired video output

13 is achieved.

14   The blue component of the video signal, along with the

15 encoded vertical synchronization signal, is initially

16 transmitted to blue variable gain amplification circuit

17 710c, blue variable frequency compensation circuit 712c,

18 and filtering enablement circuit 725, which is employed to

19 increase the range of red variable frequency compensation

20 amplifier 712a, green variable frequency compensation

21 amplifier 712b, and blue variable frequency compensation

22 amplifier 712c when the video signals have been transmitted

23 over approximately four hundred fifty (450) feet. The

24 vertical synchronization signal, which is encoded on the

1 blue component of the video signal as a precise square wave

2 signal of known duration and amplitude, is used as a

3 precise reference point for filtering enablement circuit

4 725. The blue component of the video signal and the

5 encoded vertical synchronization signal are received by

6 slow peak detector 724, which detects the amplitude of the

7 vertical synchronization signal. Slow peak detector 724

8 transmits a signal representing the amplitude of the

9 vertical synchronization signal to comparator 728, which

10 compares it to the known amplitude of a similar signal

11 transmitted for four hundred fifty (450) feet. This known

12 amplitude is represented by a constant reference voltage

13 applied to comparator 728 by voltage source 726. If

14 comparator 728 determines that the vertical synchronization

15 signal (and therefore all of the video signals) have been

16 transmitted over four hundred fifty (450) feet, a signal

17 indicating this is transmitted to video switch 730. Video

18 switch 730 then sends a signal to red variable frequency

19 compensation amplifier 712a, green variable frequency

20 compensation amplifier 712b, and blue variable frequency

21 compensation amplifier 712c to increase the range of each

22 frequency compensation amplifier 712a, 712b, and 712c.

23 Subsequent to gain amplification by gain amplification

24 adjustment circuit 715 and frequency compensation by

1   frequency compensation amplification adjustment circuit

2   735, the conditioned red, green, and blue components of the

3   video signal are transmitted to video monitor 104 of the

4   local user workstation via wire 722 and video port 312.

5   Turning next to FIG. 3A, depicted is a schematic

6   representation of MSU 112, which enables multiple users

7   operating multimedia user workstations 100 to access and

8   operate multiple remote computers 118. In the preferred

9   embodiment of the present invention, access to remote

10 computer 118 from multimedia user workstation 100 is

11 performed solely via one or more MSUs 112, independent of

12 any network that may couple the remote computers 118 to

13 each other such as a LAN, WAN, etc. In other words, the

14 preferred embodiment of the computer management system of

15 the present invention does not use an existing computer

16 network to allow a multimedia user workstation 100 to

17 access and control remote computers 118. Rather, all

18 physical connections between multimedia user workstation

19 100 and remote computer 118 occur through one or more MSUs

20 112.

21   In the preferred embodiment of the present invention,

22 each port 202 is an RJ-45 socket that allows one multimedia

23 CIM 116 to be connected to its own, dedicated port 202 via

24 cable 114 (FIG. 1). The uni-directionally transmitted

1 (i.e., from remote computer 118 to multimedia user

2 workstation 100 only) video signals are received at MSU 112

3 via port 202 onto video bus 222, whereupon these signals

4 are transmitted to video differential switch 206. Video

5 differential switch 206 is capable of routing any video

6 signal received from video bus 222 to any port 216.

7 Therefore, video differential switch 206 transmits the

8 video signals to the specific port 216 that is connected to

9 the desired multimedia UST 108 via single cable 110 (FIG.

10 1). Multimedia UST 108 then applies the received video

11 signals to video monitor 104.

12   In addition to routing the unidirectional video

13 signals, MSU 112 also bi-directionally transmits keyboard,

14 cursor control device, administrative, audio and auxiliary

15 peripheral device signals between multimedia USTs 108 and

16 multimedia CIMs 116. Administrative signals are signals

17 created internal to the computer management system of the

18 present invention based upon the input of a system

19 administrator or a system programmer. In the preferred

20 embodiment of the present invention, such input is provided

21 via keyboard 102 and cursor control device 106 of

22 multimedia user workstation 100 in response to a menu

23 displayed on video monitor 104. One such administrative

24 feature allows a system administrator to designate one or

1   more remote computers 118 as blocked (i.e., only the system

2   administrator may access the remote computer 118 and all

3   other system users are blocked from accessing it). Another

4   similar feature allows the system administrator to

5   deactivate a user profile without deleting it. Both of

6   these features allow the system administrator to modify

7   access to remote computers and modify user profiles with

8   simple commands in lieu of physical disconnection of remote

9   computers 118 or regeneration of user profiles.

10   When routing the keyboard, cursor control device,

11 administrative, audio and auxiliary peripheral device

12 signals from multimedia CIM 116 to multimedia UST 108,

13 these signals are received from multimedia CIM 116 in the

14 form of a data packet, as illustrated in FIG. 5, through

15 ports 202 onto peripheral bus 220. Thereafter, the data

16 packets are transmitted to peripheral switch 214, which

17 transmits the received data packet to the appropriate first

18 transceiver 241. First transceiver 241 then transmits the

19 signals to MSU central processing unit ("CPU") 212 for

20 processing. MSU CPU 212 processes the received data packet

21 and generates a new data packet.

22   As shown in FIG. 3B, which depicts a schematic diagram

23 of the preferred embodiment of first transceiver 241 and

24 second transceiver 230, the data packet arrives from

1 peripheral switch 214 at signal converter 250 which

2 converts the data packet from a differential form to its

3 original form. The data packet is then transmitted to

4 decoder 252 (preferably a Manchester decoder) which decodes

5 the encoded data packet. After the data packet has been

6 processed by decoder 252, the data packet is de-serialized

7 by de-serializer 254 which converts the serial stream of

8 bits in the data packet into parallel streams of bits.

9 Command extractor 256 then processes the de-serialized data

10 packet to remove the portion of the data packet relating to

11 keyboard, cursor control device, and administrative

12 signals. MSU CPU 212 utilizes the removed portion of the

13 data packet to determine the proper second transceiver 230

14 to which to transmit the remainder of the data packet.

15   The remainder of the data packet is then transmitted

16 from command extractor 256 to command combiner 258 located

17 in second transceiver 230 as determined by MSU CPU 212.

18 Command combiner 258 appends a new set of keyboard, cursor

19 control device, and administrative signals created by MSU

20 CPU 212 to the data packet received from command extractor

21 256. The data packet is then serialized by serializer 260

22 and encoded by encoder 262. Next, signal converter 264

23 conditions the data packet for transmission over a single

24 CAT 5 cable by converting the data packet to a differential

1 signal for transmission over a single twisted pair located

2 in the CAT 5 cable and by applying the proper network

3 protocol to the data packet. The data packet is then

4 transmitted to port 216. Alternatively, under software

5 control, the entire data packet may be transmitted from

6 command extractor 256 to command combiner 258 without

7 passing through MSU CPU 212 as previously described (shown

8 as dotted line arrow). When in this "by-pass" mode of

9 operation, the data packet is still being sent to MSU CPU

10 212.

11   Similarly, data packets containing encoded keyboard,

12 cursor control device, administrative, audio, and auxiliary

13 peripheral device signals are also transmitted to

14 peripheral switch 214 from port 216 utilizing first

15 transceiver 241 and second transceiver 230. In this

16 scenario, the data packet arrives from port 216 at signal

17 converter 264 located in second transceiver 230 which

18 converts the data packet from a differential form to its

19 original form. Signal converter 264 also removes network

20 protocol conditioning which occurs when the data packet is

21 transmitted over a single CAT 5 cable. The data packet is

22 then transmitted to decoder 266. After the data packet has

23 been processed by decoder 266, the data packet is de-

24 serialized by de-serializer 268. Command extractor 270

1   then processes the de-serialized data packet to remove the

2   portion of the data packet relating to keyboard, cursor

3   control device, and administrative signals. MSU CPU 212

4   utilizes the removed portion of the data packet to

5   determine the proper first transceiver 241 to which to

6   transmit the remainder of the data packet. Alternatively,

7   under software control, the entire data packet may be

8   transmitted from command extractor 270 to command combiner

9   272 without passing through MSU CPU 212 as previously

10   described.

11   The remainder of the data packet is then transmitted

12   from command extractor 270 to command combiner 272 located

13   in first transceiver 241 as determined by MSU CPU 212.

14   Command combiner 272 appends a new set of keyboard, cursor

15   control device, and administrative signals created by MSU

16   CPU 212 to the data packet received from command extractor

17   270. The data packet is then serialized by serializer 274

18   and encoded by encoder 276. Next, signal converter 250

19   conditions the data packet for transmission over a single

20   CAT 5 cable by converting the data packet to a differential

21   signal for transmission over a single twisted pair located

22   in the CAT 5 cable and by applying the proper network

23   protocol to the data packet. The data packet is then

24   transmitted to peripheral switch 214.

1   Thereafter, the information pertaining to the new data

2   packet is transmitted to the appropriate second transceiver

3   230 which creates and serializes the data packet and

4   transmits it to port 216 for transmission via single cable

5   110 to the desired multimedia UST 108 (FIG. 1). Multimedia

6   UST 108 then processes the data packet and emulates

7   keyboard, cursor control device, audio, and auxiliary

8   peripheral device signals to keyboard 102, cursor control

9   device 106, UST audio output device 120, and UST I/O module

10   124, respectively (FIG. 1).

11   Similarly, MSU 112 also transmits keyboard, cursor

12   control device, administrative, audio, and auxiliary

13   peripheral device signals from multimedia USTs 108 to

14   multimedia CIMs 116 (FIG. 1). In this scenario, these

15   signals are received at multimedia UST 108 from the

16   respective connected devices, wherein information relating

17   to the received signals is packetized and transmitted via

18   cable 110 to the port 216 located at MSU 112. Thereafter,

19   the data packet is transmitted to second transceiver 230,

20   which de-serializes it and transmits it to MSU CPU 212.

21   MSU CPU 212 interprets the information contained in the

22   data packet and creates information to be contained in a

23   new data packet, as discussed above. The information

24   relating to the new data packet is then transmitted to the

1   specific first transceiver 241 that is associated with the

2   desired remote computer 118. First transceiver 241 creates

3   and serializes the data packet and transmits it to

4   peripheral switch 214, which transmits the data packet to

5   the desired port 202 via peripheral bus 220. Subsequently,

6   the data packet is transmitted via cable 114 to the

7   specific multimedia CIM 116 that is connected to the

8   desired remote computer 118 (FIG. 1). Multimedia CIM 116

9   processes the data packet and emulates the keyboard, cursor

10 control device, audio, and auxiliary peripheral device to

11 the corresponding devices.

12   Turning next to FIG. 4A, shown is a schematic diagram

13 of the interior of multimedia CIM 116. Multimedia CIM 116

14 is compatible with all present day computer systems

15 including, but not limited to, those manufactured by

16 Microsoft (Windows), Apple (Macintosh), Sun (Unix), DEC,

17 Compaq (Alpha), IBM (RS/6000), HP (HP9000), and SGI.

18 However, it is foreseeable that the technology of the

19 present invention will also be compatible with those

20 computer systems not yet contemplated.

21   Multimedia CIM 116 interfaces video port 412, keyboard

22 port 414, and cursor control device port 416 of remote

23 computer 118 to the intelligent, modular computer

24 management system of the present invention. Multimedia CIM

1 116 also interfaces CIM audio output device 126, CIM audio

2 input device 128, and CIM I/O module 130 to the computer

3 management system of the present invention. However, these

4 devices may either be integral to or independent from

5 remote computer 118. For example, multimedia CIM 116 may

6 interface directly to the audio in port and audio out port

7 of remote computer 118 or may interface to an independent

8 audio input device, such as a microphone, and an

9 independent audio output device, such as a speaker.

10   Video port 412, keyboard port 414, and cursor control

11 device port 416 of remote computer 118 are connected to

12 port 400 of multimedia CIM 116 via a specially manufactured

13 modular cable 418. Modular cable 418 contains a first end

14 with a connector for coupling modular cable 418 to

15 multimedia CIM 116, and a second end containing three

16 connectors for coupling modular cable 418 to video port

17 412, keyboard port 414, and cursor control device port 416.

18 Preferably, separate audio ports 422 and 424 are used for

19 connecting audio output device 126 and audio input device

20 128. In an alternate embodiment, a five or six prong

21 modular cable can be specially manufactured to allow port

22 400 of multimedia CIM 116 to connect to the video,

23 keyboard, cursor control device, audio in, and audio out

24 ports of remote computer 118, and optionally to CIM I/O

1 module 130. In yet another embodiment, multimedia CIM 116

2 may be connected to the audio input and audio out ports of

3 remote computer 118 via industry standard audio cabling.

4   In the preferred embodiment of the present invention,

5 multimedia CIM 116 may be connected to the audio input and

6 audio out ports of remote computer 118, CIM audio output

7 device 126, and CIM audio input device 128 via a

8 multipurpose audio cable. The multipurpose audio cable

9 contains a first end that couples to CIM audio in port 424

10 and CIM audio out port 422. The second end of the

11 multipurpose cable contains two audio input connectors and

12 two audio output connectors. The two audio input

13 connectors couple to CIM audio input device 128 and the

14 audio out port of remote computer 118. The two audio

15 output connectors couple to CIM audio output device 126 and

16 the audio in port of remote computer 118. This cable

17 configuration allows a system user to send audio to both

18 CIM audio output device 126, such as speakers, and to the

19 audio in port of remote computer 118. Furthermore, the

20 multipurpose cable allows a system user to receive audio

21 generated either internal to remote computer 118 or

22 externally, such as a person speaking into a microphone

23 that is connected to multimedia CIM 116. Optionally, the

24 audio cable may contain a switching mechanism for switching

1   between the two input connectors and the two output

2   connectors located at the second end of modular cable.

3   In the preferred embodiment of the present invention,

4   CIM I/O module 130 is connected to CIM I/O port 426 via a

5   40-pin ribbon cable. However, as discussed above with

6   respect to UST I/O module 124, it will be apparent to one

7   of skill in the art that multimedia CIM 116 and CIM I/O

8   module 130 can be designed to utilize any type of cabling

9   to couple CIM I/O module 130 to multimedia CIM 116. Also,

10 as discussed above with respect to UST I/O module 124, CIM

11 I/O module 130 may be designed to include one or more

12 ports, including varying types of ports, which interface

13 one or more auxiliary peripheral devices to CIM I/O module

14 130.

15   CIM CPU 406 receives keyboard and cursor control

16 device signals from keyboard port 414 and cursor control

17 device port 416 of remote computer 118, respectively.

18 Thereafter, CIM CPU 406 analyzes the received signals and

19 transmits information to CIM transceiver 408 via data

20 converter 420 to be used during generation of a data

21 packet. Simultaneously, data converter 420 receives

22 signals from CIM I/O module 130 and CIM audio input device

23 128 via CIM I/O port 426 and CIM audio in port 424,

24 respectively. The I/O module signals and audio signals are

1   processed by data converter 420 and transmitted to CIM

2   transceiver for transmission to MSU 112 via port 402 and

3   cable 114.

4   FIG. 4B shows a schematic diagram of the preferred

5   configuration of CIM transceiver 408 and data converter

6   420. As shown, the CIM I/O module signals are received

7   from CIM I/O module 130 via CIM I/O port 426 and are input

8   to bit converter 450 located in data converter 420.

9   Similarly, the audio signals are received from CIM audio

10   input device 128 via UST audio in port 424 and are

11   converted to digital signals by analog-digital converter

12   ("AD converter") 452. The resulting digitized audio

13   signals are input to audio rate converter 454 which formats

14   the rate of data flow. Additionally, signals relating to

15   the keyboard and cursor control device information are

16   received from CIM CPU 406 and are input to serial rate

17   converter 456 which serializes the keyboard and cursor

18   control device signals.

19   CIM transceiver 408 combines the signals received from

20   audio rate converter 454, serial rate converter 456, and

21   bit converter 450 to create data packets in packetizer 458

22   as discussed in further detail with respect to FIG. 5. It

23   should be noted that the I/O module signals typically

24   contain the same information as the auxiliary peripheral

1 device signals mentioned above. The reason for this is

2 that CIM I/O module 130 and UST I/O module 124 are used to

3 interface auxiliary peripheral devices to multimedia CIM

4 116 and multimedia UST 108, respectively. In addition, the

5 data packet contains overhead data, also discussed in more

6 detail regarding FIG. 5. Thereafter, CIM transceiver 408

7 converts the data packets to a serial format utilizing

8 serializer 460 and encodes the data packet utilizing

9 encoder 462. Signal converter 464 then conditions the data

10 packet for transmission over cable 114 by converting the

11 data packet to a differential signal for transmission over

12 a single twisted pair located in cable 114 and by applying

13 the proper network protocol to the data packet. The data

14 packet is then transmitted to port 402 for transmission to

15 MSU 112 via cable 114. Timing circuit 466 directs

16 serializer 460 and signal converter 464 to create a new

17 data packet every twenty five (25) microseconds to ensure

18 constant data flow.

19   Keyboard, cursor control device, I/O module, and audio

20 signals in the form of a data packet are received from MSU

21 112 via cable 114 at port 402. Signal converter 464

22 located in CIM transceiver 408 converts the data packet

23 from a differential form to its original form and removes

24 network protocol conditioning performed by MSU 112. The

1 data packet is next decoded by decoder 468 and de-

2 serialized by de-serializer 470. Timing circuit 466

3 instructs de-serializer 470 to de-serialize a data packet

4 every twenty (20) microseconds to ensure constant data

5 packet flow. The data packet is then processed by

6 separator 472 which parses the data packet into its

7 original components.

8   The received audio signals are processed by audio rate

9 converter 474. The digital audio signals are then

10 converted to analog signals in audio digital-to-analog

11 converter ("DAC converter") 476 and undergo signal

12 amplification by signal amplifier 478. The amplified

13 analog audio signals are then applied to CIM audio out port

14 422.

15   The received I/O module signals are conditioned by bit

16 shifter 480 and transmitted to CIM I/O module 130 via CIM

17 I/O module port 426. The keyboard and cursor control

18 device signals are processed by rate converter 482 and

19 passed through data converter 420 to CIM CPU 406 which uses

20 the information contained in the signals to emulate

21 keyboard and cursor control device signals. These emulated

22 signals are applied to keyboard 102 and cursor control

23 device 106 via keyboard port 400 and cursor control device

24 port 410, respectively (FIG. 4A).

1   Similarly, keyboard, cursor control device, I/O

2   module, and audio signals received from MSU 112 via cable

3   114 (FIG. 1) are received via port 402. CIM transceiver

4   408 receives, de-serializes, and transmits these signals to

5   data converter 420. Data converter 420 processes the audio

6   signals and transmits the audio signals to CIM audio output

7   device 126 via CIM audio out port 422. The received I/O

8   module signals are processed by data converter 420 and then

9   transmitted to CIM I/O module 130 via CIM I/O port 426.

10   The keyboard and cursor control device signals are

11   processed by data converter 420 and then are passed to CIM

12   CPU 406, which uses the information contained in the

13   signals to emulate keyboard and cursor control device

14   signals. These emulated signals are applied to keyboard

15   port 414 and cursor control device port 416 via port 400.

16   As discussed in greater detail above for FIG. 2A with

17   respect to UST CPU 308, CIM CPU 406 is also programmed to

18   emulate keyboard and cursor control device signals that are

19   compatible with the communication protocol of the connected

20   remote computer 118, even though the original keyboard and

21   cursor control device signals generated at the origination

22   multimedia UST 108 may not be compatible with the remote

23   computer's protocol.

1   Video signals are transmitted from video port 412 of

2   remote computer 118 to multimedia CIM 116 via modular cable

3   418 to port 400. From port 400, the video signals are

4   transmitted to video driver 404, which converts the

5   standard red, green, and blue components of the video

6   signal to differential signals for transmission through

7   port 402 to cable 114. Each color signal is transmitted

8   via its own twisted pair cable contained within cable 114

9   (when transmitted from multimedia CIM 116 to MSU 112) and

10   single cable 110 (when transmitted from MSU 112 to

11   multimedia UST 108) (FIG. 1). Furthermore, video driver

12   404 appends the horizontal and vertical synchronization

13   signals to one of the red, green, or blue video signals to

14   allow all five components of the video signal to be

15   transmitted via only three twisted pair cables of cables

16   110 or 114. That is, the horizontal and vertical

17   synchronization signals are each transmitted on their own

18   color signal -- not the same color signal.

19   Furthermore, multimedia CIM 116 contains memory unit

20   410, which stores the address and status of the connected

21   remote computer 118. Thus, if a specific remote computer

22   118 is not functioning properly, it is easy to assess which

23   remote computer 118 has malfunctioned. In addition, the

24   device address facilitates proper switching of the

1 keyboard, cursor control device, audio, and auxiliary

2 peripheral device signals since the device address is

3 included in the generated data packets that contain the

4 transmitted signal information. Therefore, the information

5 contained in memory unit 410 maintains the modular nature

6 of the computer management system of the present invention.

7   Finally, in the preferred embodiment of the present

8 invention, remote computer 118 provides power to multimedia

9 CIM 116. Thus, the preferred embodiment of the present

10 invention eliminates the equipment, cabling, and space

11 required for a dedicated multimedia CIM 116 power source.

12   Referring now to FIG. 6, shown is a timing diagram

13 depicting the transmission of data packet 500 from

14 multimedia UST 108 to multimedia CIM 116 and vice versa

15 according to the preferred embodiment of the invention.

16 Multimedia CIM 116 initially forms a data packet from the

17 keyboard, cursor control device, administrative, audio, and

18 auxiliary peripheral device signals. Multimedia UST 108

19 conditions the data packet for transmission to MSU 112 via

20 cable 110 (FIG. 1) in UST transmission step 602.

21 Typically, the formation of the data packet takes

22 approximately 6.4 microseconds. While undergoing

23 transmission, the data packet experiences approximately a

24 1.5 nanosecond per foot cable delay.

1   The data packet is received at MSU 112 step 604. As

2   previously described, MSU 112 processes the data packet to

3   determine the proper multimedia CIM 116 to which to

4   transmit the data packet. This processing typically takes

5   about 0.2 microseconds. MSU 112 then retransmits the data

6   packet to multimedia CIM 116 via cable 114 step 606.

7   Again, the data packet experiences about a 1.5 nanosecond

8   per foot cable delay while being transmitted over cable

9   114.

10   Multimedia CIM 116 receives and processes the data

11   packet in step 608. The keyboard, cursor control device,

12   audio, and auxiliary peripheral device signals are then

13   transmitted to the appropriate attached peripheral devices

14   (FIG. 4A and FIG. 4B). In response to the inbound data

15   packet, multimedia CIM 116 prepares a new data packet

16   containing keyboard, cursor control device, administrative,

17   audio, and auxiliary peripheral device signals formed at

18   remote computer 118. The formation of the new outbound

19   data packet by multimedia CIM 116 takes approximately 6.4

20   microseconds. After the formation of the new outbound data

21   packet is complete, multimedia CIM 116 transmits the data

22   packet to MSU 112 via cable 114 in step 610. The data

23   packet experiences about a 1.5 nanosecond per foot cable

24   delay during transmission over cable 114.

1   MSU 112 receives the data packet from multimedia CIM

2 116 step 612. MSU 112 processes the data packet to

3 determine the proper multimedia UST 108 to which to

4 transmit the data packet. This processing typically takes

5 about 0.2 microseconds. MSU 112 then retransmits the data

6 packet to multimedia UST 108 via single cable 110 in step

7 614. The data packet experiences approximately a 1.5

8 nanosecond per foot cable delay while being transmitted

9 over cable 110 to multimedia UST 108.

10   The data packet is received at multimedia UST 108 in

11 step 616. Once the data packet has been received,

12 multimedia UST 108 transmits a new data packet to

13 multimedia CIM 116 according to the timing diagram just

14 described. Transmission of a data packet from multimedia

15 UST 108 to multimedia CIM 116 and from multimedia CIM 116

16 to multimedia UST 108 takes approximately twenty (20)

17 microseconds for completion. Importantly, the timing

18 diagram of FIG. 6 is merely exemplary of the timing of the

19 data packets within the system according to the invention.

20 Other transmission times are possible while maintaining the

21 purpose and function of the invention.

22   Referring next to FIG. 7, disclosed is an alternate

23 embodiment of the intelligent, modular computer management

24 system of the present invention in which the system is

1   expanded to include two MSUs 801 and 802, each having eight

2   (8) inputs and thirty-two (32) outputs. This configuration

3   allows sixteen (16) USTs 108 to access and operate thirty-

4   two (32) connected computers 118. In this alternate

5   embodiment, each UST 108 may be linked to either first MSU

6   801 or second MSU 802 via cable 110. All signals received

7   at UST 108 are transmitted via its connected MSU (i.e.,

8   either first MSU 801 or second MSU 802) to CIM 116 that is

9   connected to the desired connected computer 118. In this

10   alternate embodiment, CIM 116 provides connectors for two

11   (2) cables 114 to allow it to connect to both first MSU 801

12   and second MSU 802. Thus, CIM 116 allows sixteen (16) user

13   workstations 100 to operate thirty-two (32) connected

14   computers 118.

15   In addition, this embodiment allows two (2) user

16   workstations 100 to simultaneously access and operate the

17   same connected computer 118. Alternatively, this

18   embodiment allows a first user workstation 100 to inform a

19   second user workstation 100 that a connected computer 118

20   is in use and, therefore, access to it is restricted.

21   Turning next to FIG. 8, disclosed is another alternate

22   embodiment of the remote computer management system of the

23   present invention. The use of forty (40) total MSUs (i.e.,

24   eight (8) first tier MSUs 902 and thirty-two (32) second

1   tier MSUs 904), wherein each first tier MSU 902 and second

2   tier MSU 904 has eight (8) inputs and thirty-two (32)

3   outputs, allows sixty-four (64) user workstations 100 to

4   operate and access one thousand twenty four (1,024)

5   connected computers 118. In this alternate embodiment,

6   each UST 108 is directly linked to one of eight (8) first

7   tier MSUs 702 via single CAT 5 cable 906. First tier MSU

8   902 transmits all signals received from user workstation

9   100 via single CAT 5 cable 908 to second tier MSU 904 that

10   is connected to the CIM 116 associated with the desired

11   connected computer 118. Second tier MSU 904 then transmits

12   the received signals to the respective CIM 116 via single

13   CAT 5 cable 910, whereupon CIM 116 applies these signals to

14   the respective ports of connected computer 118. In this

15   embodiment, the second tier of MSUs 904 comprises thirty-

16   two (32) units. Each second tier MSU 904 is coupled to

17   multiple CIMs 116, which provide a direct connection to

18   each of the one thousand twenty four (1,024) potential

19   connected computers 118 via single CAT 5 cables 910.

20   Although FIG. 8 depicts the configuration used to

21   access and control one thousand twenty four (1,024)

22   connected computers 118 from sixty-four (64) user

23   workstations 100, many other system configurations are

24   available to allow a greater number of user workstations

1   100 to be connected to a greater number of connected

2   computers 118. For example, the number of MSU tiers may be

3   increased, or, alternatively, hubs may be incorporated.

4   Also, each MSU may be designed to comprise more than eight

5   (8) inputs and more than thirty-two (32) outputs to further

6   increase the system capacity.

7   While the present invention has been described with

8   reference to the preferred embodiment and several

9   alternative embodiments, which embodiments have been set

10 forth in considerable detail for the purposes of making a

11 complete disclosure of the invention, such embodiments are

12 merely exemplary and are not intended to be limiting or

13 represent an exhaustive enumeration of all aspects of the

14 invention. The scope of the invention, therefore, shall be

15 defined solely by the following claims. Further, it will

16 be apparent to those of skill in the art that numerous

17 changes may be made in such details without departing from

18 the spirit and the principles of the invention. It should

19 be appreciated that the present invention is capable of

20 being embodied in other forms without departing from its

21 essential characteristics.

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